

DEGRADATION OF TRICHLOROETHENE (TCE) IN A FRACTURED BEDROCK AQUIFER USING SODIUM PERMANGANATE

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In situ application of chemical oxidants has been increasingly utilized in the past decade as a relatively quick and effective means of remediating chlorinated ethenes occurring in soil and groundwater. An adequate understanding of in situ chemical oxidation (ISCO) technologies exists for permeable groundwater aquifers with limited heterogeneity; however, understanding is not complete for more complex sites such as those with fractured bedrock (Seigrist, 2001). Research, development and rigorous technology evaluations have previously focused predominately on unconsolidated materials; particularly settings with relatively simple geology and shallow contamination. Because most practitioners have more familiarity with investigation and remediation in unconsolidated settings, the result is an industry that has been addressing remediation of fractured rock sites primarily by drawing on expertise and conceptual approaches developed in unconsolidated deposits (EPA, 2001).

This presentation describes a full-scale ISCO implementation using sodium permanganate to remediate a dissolved trichloroethene (TCE) plume occurring in a fractured bedrock aquifer. The dissolved phase TCE plume originated from a facility that has manufactured automotive components since 1956. The geology and hydrogeology of the site has been extensively characterized using remote sensing techniques, downhole geophysical surveys, hydraulic testing, and groundwater modeling. The hydrogeology of the site is dominated by partially weathered rock (schist and gneiss). Contaminant transport is controlled by lineaments consisting of fractured pegmatites and quartz veins in the partially weathered rock and underlying component bedrock. The dissolved TCE exists as a bifurcated plume that has migrated to adjacent commercial and residential properties via the highly conductive fractured zones.

A two-phased pilot test demonstrated the effectiveness of ISCO in degrading the dissolved TCE plume. The pilot tests involved the injection of a dilute sodium permanganate solution under both pumping and natural flow conditions. A full-scale ISCO program is currently being implemented to remediate the portion of the TCE plume beneath a residential and commercial neighborhood adjacent to the facility. The first semi-annual oxidant injections were completed in February 2003. Oxidant injections were accomplished through gravity feed of a dilute sodium permanganate solution to the screened zone of eight injection wells. Injection volumes ranged from 250 to 500 gallons with a 2 % oxidant solution. Two performance monitoring wells located in the vicinity of the injection wells have shown decreasing TCE concentrations accompanied by the presence of oxidant degradation indicators, such as manganese dioxide, carbon dioxide, and decreasing groundwater pH.